UL 6420

STANDARD FOR SAFETY

Equipment Used for System Isolation and Rated as a Single Unit

UL Standard for Safety for Equipment Used for System Isolation and Rated as a Single Unit, UL 6420

First Edition, Dated October 19, 2012

Summary of Topics

This revision of ANSI/UL 6420 is being issued to update the title page to reflect the reaffirmation of ANSI approval.

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

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Standard for Equipment Used for System Isolation and Rated as a Single Unit

First Edition

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This ANSI/UL Standard for Safety consists of the First Edition including revisions through January 8, 2018.

The most recent designation of ANSI/UL 6420 as a Reaffirmed American National Standard (ANS) occurred on January 8, 2018. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at https://csds.ul.com.

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(informative)

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1 Scope and Object

1.1 Scope

1.1.1 General

1.1.1.1 This standard applies to isolating equipment incorporating electromechanical contactors remotely controlled and monitored to provide remote isolation status indication with a defined integrity level. This equipment is intended for use as an additional isolating means on the load side of the required supply-disconnecting device and over current protection. This standard applies to isolating equipment that is to be used in circuits of which the rated voltage does not exceed 1000 Vac or 1500 Vdc.

1.1.1.2 The system isolation equipment is expected to be used both as a means for removal of power for prevention of unexpected start-up of a stopped machine and as an isolator to provide protection from electric shock by ensuring the removal of electrical energy.

1.1.1.3 This equipment is intended for installation in accordance with the National Electrical Code, NFPA 70 and the Electrical Standard for Industrial Machinery, NFPA 79:2012.

Note – Reference to System Isolation Equipment is found in Article 430.109(A)(7) of the National Electrical Code NFPA 70; in Clause 5.5.4(3), Devices for Disconnecting (Isolating) Electrical Equipment, of the Electrical Standard for Industrial Machinery, NFPA 79:2012; and in Clause 5.3.2(d) of the Standard for Safety of Machinery – Electrical Equipment of Machines – Part 1: General Requirements, IEC 60204-1.

1.1.1.4 The System Isolation Equipment is not intended to fulfill the function of a motor starter or other motion control device.

1.1.2 System isolation equipment

1.1.2.1 Typical application

1.1.2.1.1 The system isolation equipment is principally intended for industrial machine applications where, isolation of power is so frequently required that the mechanical life of a typical disconnecting means is unacceptably short or where there are multiple entry points on the machine where disconnection is required, or both.

Note – Multiple entry points are a function of access needs and the layout of the machine.

1.2 Object

1.2.1 The object of this standard is to state:

a) The characteristics of the system isolation equipment;

b) The conditions of operation and behavior for the system isolation equipment, its dielectric properties, and the degree of protection provided by its enclosure where applicable;

c) The information to be marked on or given with the system isolation equipment;

d) The normal service, mounting and transport conditions of the system isolation equipment;

e) The construction and performance of the system isolation equipment;

f) The tests intended to verify that these conditions have been met, and the methods to be adopted for these tests.

2 Normative References

2.1 The following normative documents contain provisions, which, through reference in this text, constitute provisions of this standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies.

UL 60947-1
Standard for Low-Voltage Switchgear and Controlgear – Part 1: General Rules

UL 60947-4-1A
Standard for Low-Voltage Switchgear and Controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters

NFPA 79:2012
Electrical Standard for Industrial Machinery

3 Definitions

3.1 For the purpose of this standard, the definitions of Clause 2 of the Standard for Low-Voltage Switchgear and Controlgear – Part 1: General Rules, UL 60947-1, and the definitions of Clause 3 of the Standard for Low-Voltage Switchgear and Controlgear – Part 4-1A: Contactors and Motor-Starters – Electromechanical Contactors and Motor-Starters, UL 60947-4-1A, together with the following definitions apply.

3.2 CONNECTED EQUIPMENT – All circuits that are isolated by the system isolation equipment.

3.3 MIRROR CONTACT – Normally closed auxiliary contact, which cannot be in closed position simultaneously with the normally open main contact.

Note – For more information see the Requirements for Auxiliary Contact Linked with Power Contact (Mirror Contact), in the Standard for Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters, IEC 60947-4-1, Annex F. One contactor may have more than one mirror contact.

3.4 MONITORED CIRCUITS – Control circuits that are designed so that their function(s) are checked for failure continuously or at suitable intervals by the control system.

3.5 REDUNDANTLY MONITORED – Control circuits that are monitored through the use of multiple path systems.

3.6 STOP CATEGORY 1 – A controlled stop with power to the machine actuators available to achieve the stop then remove power when the stop is achieved. (Electrical Standard for Industrial Machinery, NFPA 79:2012, Clause 9.2.2, Stop functions.)

3.7 SUPPLY DISCONNECT – Disconnecting means to remove incoming power supplied to a machine.

3.8 SYSTEM ISOLATION EQUIPMENT – Equipment packaged to provide the disconnection/isolation function separate from the supply disconnect and capable of operation from multiple remote locations by means of lockout switches. Each lockout switch is capable of being padlocked in the OFF (open) position. Visual indication is provided to the operator at the respective lockout station that is in the OFF (open) position when the power bus is isolated.

4 Classification of the System Isolation Equipment

4.1 General

4.1.1 This clause lists the characteristics of system isolation equipment. Information about these listed characteristics may be given by the manufacturer but may not necessarily have to be verified by testing, unless such requirements are indicated here or elsewhere in this document.

4.2 According to the system design with single or multiple power isolation points

4.2.1 A single power isolation is accomplished by isolating the power to multiple motors.

4.2.2 A multiple power isolation is accomplished by isolating the power to individual motors, groups of motors or other loads.

4.3 According to the utilization category/load designation

4.3.1 Although the system isolation equipment is not intended to be used as a motor starter or any other form of motor control, the power components and power circuits shall be appropriate for on-load switching of motors or other inductive loads of the connected equipment. The system isolation equipment's rating and load designation shall be in accordance with the Standard for Low-Voltage Switchgear and Controlgear – Part 4-1A: Contactors and Motor-Starters – Electromechanical Contactors and Motor-Starters, UL 60947-4-1A, Table 5.4DV.1. The utilization category/load designation shall be based on the construction and performance requirements found in Clause 8 and testing requirements in Clause 9.

4.3.2 Clause 5.4 of the Standard for Low-Voltage Switchgear and Controlgear – Part 4-1A: Contactors and Motor-Starters – Electromechanical Contactors and Motor-Starters, UL 60947-4-1A, applies with the following additions:

a) AC–23A: Switching of alternating current motor loads or other highly inductive loads (A = frequent use)

b) DC–23A: Switching of highly inductive direct current loads (e.g. series motors) (A = frequent use)

4.3.3 Only references to contactors in the Standard for Low-Voltage Switchgear and Controlgear – Part 4-1A: Contactors and Motor-Starters – Electromechanical Contactors and Motor-Starters, UL 60947-4-1A, apply to power control components of system isolation equipment.

4.4 According to the required safety performance

4.4.1 The system isolation equipment shall be designed to meet the requirements of Clause 5.1.2.4.

4.5 According to the normal load and overload characteristics

4.5.1 Although the system isolation equipment is not intended to be used as a motor starter or any other form of motor control, the power circuit components and power circuits shall be appropriate for carrying normal loads and over loads and for infrequent, occasional on-load switching of motors or other inductive loads. The classification shall reflect the limitations.

4.6 According to the method chosen to monitor the controlled load side power circuit

4.6.1 Methods:

a) Voltage sensing method refers to measurement of the power circuit voltage on the load side of the system isolation equipment contactor to determine whether the voltage is below a preset threshold, or

b) Voltage grounding method refers to placing a short circuit between all ungrounded conductors to the equipment grounding conductor on the load side of the system isolation equipment isolation contactor to insure that voltage is not present, or

c) Alternate monitoring methods meeting the performance requirements of Clause 4.4.1 may be used to verify that the removal of power has been achieved.

4.6.2 See Clause 5.4.

4.7 According to the configuration limits of the lockout station locations (See Annex A, Figures A.2 and A.3)

4.7.1 The maximum number of lockout station locations and the circuit distance limitations or combinations there of.

4.7.2 See Clause 5.6.

4.8 According to the available machine control interface functions

4.8.1 The system isolation equipment may be configured to meet additional machine control interface applications such as the following:

a) Safety related interface including both signal and feedback channels:

1) Guard door locked status signals;

2) Release signal for guard locks;

3) Signal to / feedback from – safety pneumatic control valve;

4) Signal from / feedback to – E-stop system;

5) Signal collected from E-stop devices to / feedback from E-stop system;

6) Signal collected from E-stop devices rapid stop signal / to machine drive control system;

7) Run permissive signal to machine drive control system;

8) Zero speed signals from drive;

9) Zero voltage signals from drive;

10) Signal to machine stop.

b) Information related interface channels:

1) Lockout switch positions (open or closed);

2) System isolation equipment components status / trouble shooting aids;

3) System isolation equipment status.

4.9 According to the reset function following restoration of power to the power circuit line terminals

4.9.1 When power to the line side of the system isolation equipment is initiated or restored, the system isolation equipment requires a manual reset before power can be made available to the connected equipment.

5 Characteristics of the System Isolation Equipment (Including the Characteristics of the Self Contained Components that are Used in the Construction of the System Isolation Equipment)

5.1 General

Note – Some of the requirements for the various components of the system isolation equipment are defined in parts of the UL 60947 series of standards. In most cases these requirements are incorporated by reference rather than restated in this Clause.

5.1.1 Control components

5.1.1.1 The control circuit components shall be selected to meet the relevant construction and performance requirements in Clause 8, Construction and performance, standards. The control circuit components shall be applied within the limits defined by their characteristics. See Clause 5.1.1.3.

Note – The requirements of control components selected to be used in system isolation equipment may be found in the Standard for Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices, IEC 60947-5-1 and the Standard for Industrial Control Equipment, UL 508.

5.1.1.2 Control circuit components shall be evaluated in order to determine their suitability in the system isolation equipment design. See Clauses 5.1.2.4 and 8.2.9.

5.1.1.3 The characteristics of control circuit devices and switching elements should be evaluated in the following terms, where applicable:

a) Type of equipment (e.g. kind of control circuit device: manual control switches, electromagnetically operated control switches, indicator lights and kind of switching elements: auxiliary contacts, interlocking contacts, control circuit contacts);

b) Rated and limiting values for switching elements (see Clause 5.1.1.4);

c) Utilization categories of switching elements (see Clause 5.1.1.10);

d) Normal and abnormal load characteristics (see Clause 5.1.1.9);

e) Switching over-voltages (see Clause 5.1.1.11);

f) Durability for the application (see Clause 8.3.4.3).

5.1.1.4 The rated and limiting values for switching elements of a control circuit device application in the system isolation equipment design shall be based on evaluations in accordance with Clauses 5.1.1.5 to 5.1.1.9 inclusive.

5.1.1.5 Rated voltage(s) of a switching element is defined by the following:

a) Rated operational voltage (U_e): Clause 4.3.1.1 of the Standard for Low-Voltage Switchgear and Controlgear – Part 1: General Rules, UL 60947-1, applies;

Note 1 – A switching elements may be assigned a number of combinations of rated operational voltage and rated operational current.

Note 2 – Control switches dealt with in the Standard for Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices, IEC 60947-5-1, and the Standard for Industrial Control Equipment, UL 508, are often not intended to be used at very low voltages and they may not be suitable for such a service. It is therefore recommended to seek the advice of the manufacturer concerning any application with a low value of operational voltage, e.g. most applications below 100 V ac or dc.

b) Rated insulation voltage (U_i): Clause 4.3.1.2 of the Standard for Low-Voltage Switchgear and Controlgear – Part 1: General Rules, UL 60947-1, applies.

Note – The selection of dielectric insulation rating should anticipate the levels appropriate to the electrical power components rated voltage of the system isolation equipment. For example if the machine where the system isolation equipment is employed has other systems with rated insulation voltages up to 690 Vac, then the dielectric test voltage to check for the proposed isolation would be 1890 V. See the Standard for Low-Voltage Switchgear and Controlgear – Part 1: General Rules, UL 60947-1, Clause 4.3.1.2, and Table 12A.

5.1.1.6 A switching element is characterized by the following currents:

a) Conventional free air thermal current (I_{th}): Clause 4.3.2.1 of the Standard for Low-Voltage Switchgear and Controlgear – Part 1: General Rules, UL 60947-1, applies.

b) Conventional enclosed thermal current (I_{the}): Clause 4.3.2.2 of the Standard for Low-Voltage Switchgear and Controlgear – Part 1: General Rules, UL 60947-1, applies.

c) Rated operational current (I_e): The first paragraph of Clause 4.3.2.3 of the Standard for Low-Voltage Switchgear and Controlgear – Part 1: General Rules, UL 60947-1, applies.

5.1.1.7 Rated frequency: Clause 4.3.3 of the Standard for Low-Voltage Switchgear and Controlgear – Part 1: General Rules, UL 60947-1, applies.

5.1.1.8 Normal and abnormal load characteristics

5.1.1.8.1 Rated making and breaking capacities and behavior of switching elements under normal conditions shall comply with the requirements given in Clause 8.3.4.2.4 and Tables 8.9 and 8.10 corresponding to the assigned utilization category and the requirements according to the rated operational voltage.

Note 1 – For a switching element to which a utilization category is assigned, it is not necessary to specify separately a making and breaking capacity.

Note 2 – A switching element used for the switching of small motors and tungsten filament lamp loads shall be assigned a utilization category given in the Standard for Low-Voltage Switchgear and Controlgear – Part 4-1A: Contactors and Motor-Starters – Electromechanical Contactors and Motor-Starters, UL 60947-4-1A, and comply with the appropriate corresponding requirements in that publication.

5.1.1.8.2 Making and breaking capacities of switching elements under abnormal conditions shall comply with the requirements given in Clause 8.3.4.1.4 and Table 8.1 corresponding to the assigned utilization category.

Note – An example of an abnormal condition of use is one where the electromagnet does not operate and the switching elements have to interrupt the making current.

5.1.1.9 Rated conditional short-circuit current: Clause 4.3.6.4 of the Standard for Low-Voltage Switchgear and Controlgear – Part 1: General Rules, UL 60947-1, applies.

5.1.1.10 Utilization categories for switching elements in the control circuits as given in Tables 5.1 and 8.11 are for purposes of evaluating the characteristics of control circuit devices and switching elements when determining their suitability for a particular system isolation equipment design.

Table 5.1
Utilization categories for switching elements

Kind of current	Category	Typical applications
Alternating current	AC-12	Control of resistive loads and solid state loads with isolation by opto-couplers
	AC-13	Control of solid state loads with transformer isolation
	AC-14	Control of small electromagnetic loads (≤72 VA)
	AC-15	Control of electromagnetic loads (>72 VA)
Direct current	DC-12	Control of resistive loads and solid state loads with isolation by opto-couplers
	DC-13	Control of electromagnets
	DC-14	Control of electromagnetic loads having economy resistors in circuit

5.1.1.11 Switching over-voltages: Clause 4.9 of the Standard for Low-Voltage Switchgear and Controlgear – Part 1: General Rules, UL 60947-1, applies.

5.1.2 Control component application architecture

5.1.2.1 In order to ascertain that the control component contacts are suitable for control circuit applications where the voltage used is below 100 V ac or dc, it is necessary to define the predicted behavior of control circuit component's contacts within an acceptable confidence level (see Note 1). If the system isolation equipment application control circuits will involve extended distances a similar analysis of the wire and control circuit component's contacts predictable behavior shall be done. The defined predictable behavior test data or similar information and other evaluation data (Clause 5.1.1.3) is to be used in addressing component failures (Clause 8.3.8) and the results of such failure on the overall design of the system isolation equipment (Clause 8.3.8.2).

Note 1 – Conventional methods to determine the predicted behavior of control circuit component's contacts within acceptable confidence levels may be done by using the precise conventional testing methods such as those found in IEC 60947-5-4, Low-Voltage Switchgear and Controlgear – Part 5: Control circuit devices and switching elements – Section 4: Methods of assessing the performance of low-energy contacts – Special tests, or using a similar methodology such as found in IEC 61810-1, Electromechanical Elementary Relays – Part 1 General requirements and IEC 61810-2, Part 2 Reliability.

Note 2 – Often the needed defined predictable behavior test data or other similar information will nominally be gathered during the development of a particular control circuit component, and verified by a third party; such test data in turn may be made available by that component manufacturer to the system isolation equipment manufacturer. Such data could be suitable for the analysis (Clause 8.3.8) of that particular control component application to the system isolation equipment design.

5.1.2.2 The effects of switching over-voltage and inrush current within the system isolation equipments' control circuits shall be addressed in the design to match the chosen components to the application.

5.1.2.3 The parts of the system isolation equipment internal control circuits or components shall, as a minimum, be designed, constructed, selected, assembled and combined, in accordance with the relevant standards, using basic safety principles.

5.1.2.4 The following requirements apply for the overall design to achieve the safety performance for the system isolation equipment.

a) In order for the system isolation equipment to achieve the required safety performance, the system isolation equipment shall be designed so that:

1) A single fault in any of the safety-related parts does not lead to a loss of the safety function; and

2) The single fault is detected at or before the next demand upon the safety functions, such as immediately, at switch-on, or at end of a machine operating cycle. If this detection is not possible, then an accumulation of faults shall not lead to a loss of the safety function.

b) If the detection of certain faults is not possible, for reasons of technology or circuit engineering, then the occurrence of further faults shall be assumed. In this situation the accumulation of faults shall not lead to loss of the safety function.

Note – For further clarification of the methods indicated herein to achieve the required safety performance, see Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design, ISO 13849-1, including Clauses 6 and 7. The term ″well-tried component″ refers to a component for a safety-related application, which has been widely used in the past with successful results in similar applications or made and verified using principles, which demonstrate its suitability and reliability for safety-related applications. In some well-tried components certain faults can also be excluded because the fault rate is known to be very low. Guidance on the Application of ISO 13849-1 and IEC 62061 in the Design of Safety-Related Control Systems for Machinery, IEC TR